

alpha

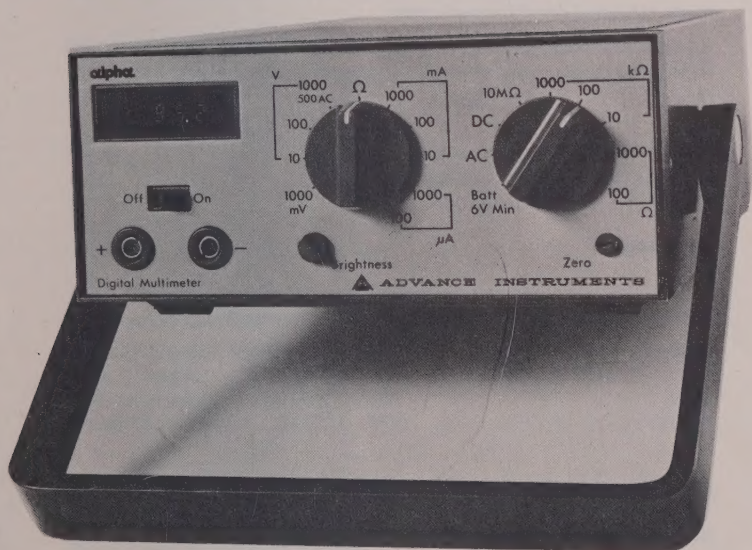
(7559)

**DIGITAL
MULTIMETER**

Instruction
Manual

ADVANCE





alpha

DIGITAL
MULTIMETER

Introduction

The Alpha is a light and compact dry-battery operated digital multimeter housed in an attractive moulded plastic case. The flicker-free display reads up to 999 with decimal points, and has automatic polarity indication on d.c. ranges. A total of 24 ranges indicates d.c. voltages from 1mV to 1000V, a.c. voltages from 1mV to 500V, d.c. and a.c. current from 0.1 μ A to 1A, and resistance from 0.1 Ω to 10M Ω .

An advanced MOS LSI circuit is used to provide all the digital circuit functions, contributing greatly to the high reliability, compactness, and low power consumption of the instrument.

Accessories available include a.c. mains and re-chargeable power supply units, and a carrying case which allows operation when hanging from the shoulder.

Specification

At 23°C $\pm$ 1°C

DC Voltage

Range	Accuracy	Input Impedance.	Max. cont. overload
1000mV	0.2% $\pm$ 1 digit.	10M	350V
10V	0.5% $\pm$ 1 digit.	11M	1kV
100V	"	10M	"
1000V	"	10M	"

AC Voltage mean sensing r.m.s. indicating

Range	Accuracy	Input Impedance.	Freq. Range.	Max. cont. overload.
1000mV		10M 75pF	40-20kHz	350V to 2kHz
10V	1%	11M "	"	500V
100V	$\pm$ 2 digits.	10M "	40- 1kHz	"
500V		10M "	"	"

DC Current

Range	Accuracy	Approx. Volt. drop	Max. cont. overload.
100 μ A	0.5% $\pm$ 1 digit.	1.0V	1A (fused)
1mA	"	"	"
10mA	"	"	"
100mA	"	"	"
1000mA	"	1.2V	"

Specification

AC Current

Range	Frequency	Accuracy	Approx. volt drop.	overload
100 μ A	40Hz- 2kHz		1.0V	1A (fused)
1mA	40Hz-20kHz		"	"
10mA	"	1.5%	"	"
100mA	"	± 2 digits	"	"
1000mA	"		1.2V	"

Resistance

Range	Accuracy	Measuring Current	Protection
100 Ω	1% $\pm$ 1 digit	10mA	10 volts, above which a 100mA fuse operates.
1000 Ω	"	1mA	
10k Ω	"	100 μ A	
100k Ω	"	10 μ A	
1000k Ω	"	1 μ A	
10M Ω	2% $\pm$ 1 digit	0.1 μ A	Open circuit voltage 12v

Temperature Coefficients

All D.C. ranges	0.02%°C
All A.C. ranges	0.05%°C
Resistance ranges	0.05%°C
except 10m Ω range	0.15%°C

Over-range is usable up to 1200 (i.e. 200 flashing), except on the 100 μ A ac range.

Quoted accuracies are for 30 days.

Accuracy on d.c. voltage and current ranges will be within 1% for 1 year, 10-30°C.

Series Mode Rejection of 50Hz on d.c. ranges greater than 30dB

Common Mode Rejection: essentially infinite when battery operated.

Operating Temperature Range: -10°C to +50°C

Power Consumption: 6.2 to 9V d.c., 10 to 45mA

Size: Height 6 cm. width 14 cm. depth 18 cm (2.4 x 5.5 x 7.1 ins)
excluding knobs, feet and handle

Weight: Instrument 570gm (1¼ lb) Battery 430gm (1lb) Total 1Kg (2¼lb)

Accessories supplied: Test leads. Red. P. No. 33317, Black 33318

Handbook, Battery 9V

Operation

ON/OFF Switch off the instrument when not in use to conserve the battery.

BRIGHTNESS Battery life will be extended by adjusting the control for the lowest usable brightness.

ZERO Select 1V d.c. range and join the input leads. Adjust zero control for a reading of 000 or -000

RESISTANCE MEASUREMENT Test lead resistance may affect the 100 Ω range readings. It can be allowed for by connecting the leads together, and subtracting the reading obtained from subsequent readings. Alternatively, use the zero control to eliminate test lead resistance, remembering to reset this for other ranges. A high current is drawn from the battery on the 100 Ω range and battery life will be shortened if left on this range with the input terminals shorted. Note also that an almost exhausted battery may drop below 6V when the 100 Ω range is in use and fail to operate the instrument correctly.

INPUT TERMINALS The + input is the low potential terminal with respect to ground

BATTERY CHECK Replace the battery if the reading is less than 600, disregard the decimal point. The reading does not indicate actual battery voltage. The table indicates the approx.

life remaining in the battery for different readings. Battery life is up to 300 hours when used 8 hours per day, dependent on brightness setting. Do not attempt to measure the battery voltage via the input sockets.

Rdg.	980	800	750	690	600
Life	100%	75%	50%	25%	0

BATTERY Press and slide out the rear panel for access to the battery. Remove the battery when exhausted or for storage.

The following 9 volt batteries are suitable types: IEC-6F100, NEDA-1603, U.K.-PP9, VT9, RR9, M1603, 439. Germany-439, 339, 495. Australia-276. Scandinavia-480, 780, LP5M9, 439, 9T1. France-6NX, R0617, 'Texas'. Italy-592, 995, A23. Japan-N572, 306. S.Africa-PM9, FM9, EF/EM. Spain-PT673. USA-D6, 276, M1603, VS306.

RANGE SELECTION A flashing display indicates overload. Observe maximum ratings on each range. The 1A range must be selected BEFORE currents greater than 100mA are applied. Do not operate the range selectors when the instrument is connected to an inductive circuit.

AC POWER SUPPLY UNIT-Type PU8 This unit fits in place of the battery. An internal adjustment must be set for 100-125V or 200-250V, 45-65Hz operation. Note that the instrument ON-OFF switch does not switch off the a.c. supply. Do not apply more than 1000V d.c. or 600V a.c. between either of the DMM8 input terminals and supply ground.

RE-CHARGEABLE BATTERY UNIT — Type BP8. See separate operating instructions.

Circuit Description

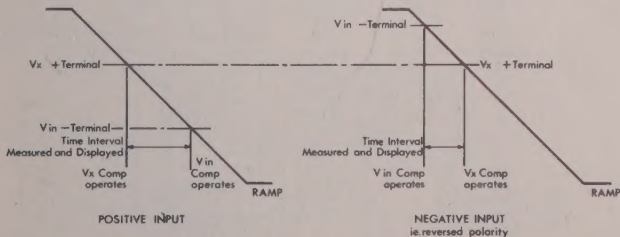
POWER SUPPLY. The battery is connected between the 5V and 10V rails, and powers a multivibrator TR1,2 which produces the 0V rail by transferring charge from C6 to C7. Similarly C2 and C8 produce the 14 volt rail. TR6 supplies a constant current to TR8 which operates as a zener diode providing a stable reference voltage.

DISPLAY. Digits are sequentially switched on by TR19-27, one for each segment, and switches TR28-34. This sequential switching is controlled by the power supply multivibrator fed via TR35 to the multiplex input of the LS1, IC2. The multiplexed output duty cycle is varied by R98 and TR35 to control the display brightness.

IC2 contains 4 counting and storage decades together with decoding to give multiplexed 7 segment outputs, and 4 digit select outputs identifying the correct digit to be illuminated.

The decimal point anode switch is operated by the instrument range switches.

ANALOGUE TO DIGITAL CONVERSION. The instrument uses a single ramp generated by C29 and TR18, reset approximately every 300ms by TR17 and applied to both comparator amplifiers. The VX comparator provides a reference, the input comparator the d.c. input information. The two diagrams show the sequence of operation of the comparators which feed IC2. Input current flowing to the input comparator is reduced by the clamping action of TR40.

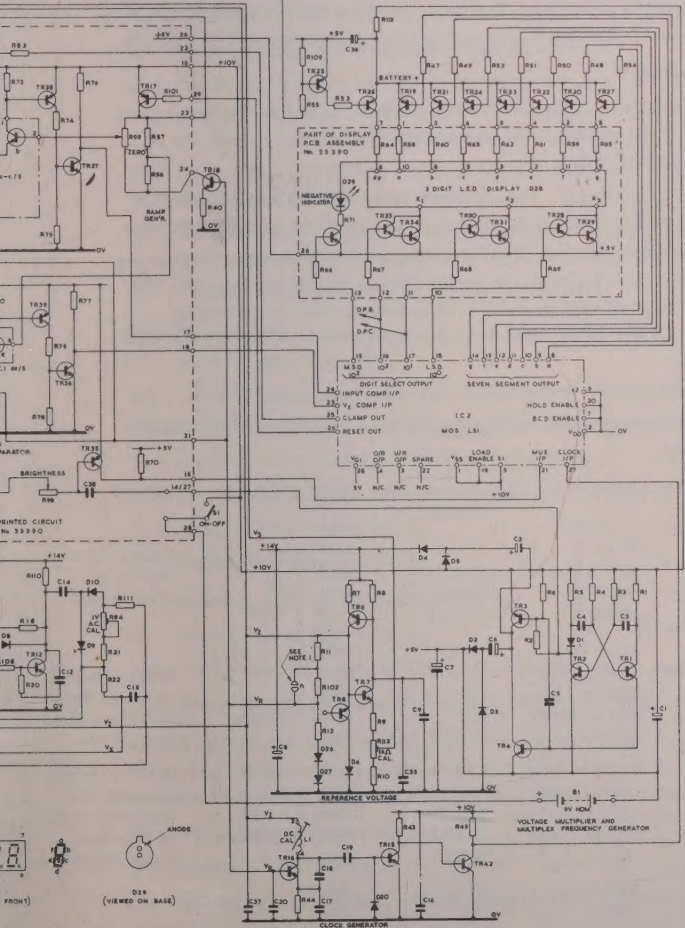


AC TO DC CONVERTER. This is a high gain differential input amplifier TR9-12 with diode rectification at the output forming an a.c. feedback path. R18 provides d.c. feedback.

OSCILLATOR. This is a Colpitts oscillator L1, TR16 followed by a squaring stage TR15 to feed IC2.

VOLTAGE RANGES. The sensitivity at IC1 pin 4 is 0.979 V for a reading of 1.000V, the input being attenuated by R87 and R19. For other ranges the input is attenuated by R84-86 and switched resistors R89, R91 and R90 plus the current shunts. For a.c. voltage measurement the attenuator is capacitively compensated.

R93	R92	R91	R90	R89	R88	R87	R86	R85	R84	R83	R82	R81	R80	R79	R78	R77	R76	R75	R74	R73	R72	R71	R70	R69	R68	R67	R66	R65	R64	R63	R62	R61	R60	R59	R58	R57	R56	R55	R54	R53	R52	R51	R50	R49	R48	R47	R46	R45	R44	R43	R42	R41	R40	R39	R38	R37	R36	R35	R34	R33	R32	R31	R30	R29	R28	R27	R26	R25	R24	R23	R22	R21	R20	R19	R18	R17	R16	R15	R14	R13	R12	R11	R10	R9	R8	R7	R6	R5	R4	R3	R2	R1	R0																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												



Operation

CURRENT RANGES. Resistors R34-38 are the shunts. The input is applied to the tap selected by the switch.

RESISTANCE MEASUREMENT. A constant current generator TR13 passes a known current through the resistor under test, the voltage developed being measured. Ranging is achieved by switched resistors at TR13 emitter.

Maintenance

CASE REMOVAL. Slide out the back panel and withdraw the battery and grommet. Unscrew both front panel retaining screws and remove the instrument from its case.

FUSE REPLACEMENT. The ohms protection fuse 100mA is located on the master board; the current protection fuse 1A, is on the switch board.

RE-CALIBRATION. Zero should be checked on each range by connecting together the input leads. If after setting zero on the 1V dc range, the 10V d.c. range does not read zero due to IC1a base current, link p or q as necessary. On the 100 Ω range zero can be adjusted to offset any test lead resistance.

Adjustments must be in the sequence shown by the table.

Inputs should be of better accuracy, e.g. 5 times better, than the Alpha specification.

SWITCH	SWITCH	INPUT	ADJUST OR CHECK	INST. READING	NOTES
1000mV	DC	1V dc	L1	1000 0.2% $\pm$ 1 digit	Reverse input Polarity and check reading
10V	DC	10V dc	CHECK	1000	
100V	DC	100V dc	CHECK	1000 0.5% $\pm$ 1 digit	
1000V	DC	1000V dc	CHECK	1000	
1000mV	AC	1V ac 1kHz	R94	1000	When measuring ac voltage the instrument must be in its case.
1000mV	AC	1V ac 20 kHz	CHECK	1000	
100V	AC	100V ac 1kHz	C24	1000 1%	
10V	AC	10V ac 20kHz	C33	1000 $\pm$ 2 digits	
500V	AC	500V ac 1kHz	CHECK	1000	
100 μ A	DC/AC	100 μ A dc	CHECK	1000 d c 0.5%	When measuring ac current the instrument must be in its case. Adjust R103 on d.c
1000 μ A	DC/AC	1mA and	CHECK	1000 $\pm$ 1 digit	
10mA	DC/AC	10mA ac	CHECK	1000 a c 1.5%	
100mA	DC/AC	100mA 1kHz	CHECK	1000 $\pm$ 2 digits.	
1000mA	DC/AC	1A	R103	1000	
1000 Ω	Ω	1000 Ω	R112	1000	Lead resistance is significant on 100 Ω range, check zero
10M Ω	Ω	10M Ω	R97	1000	
100 Ω	Ω	100 Ω	CHECK	1000 1%	
10k Ω	Ω	10k Ω	CHECK	1000 $\pm$ 1 digit.	
100k Ω	Ω	100k Ω	R96	1000	
1000k Ω	Ω	1M Ω	R95	1000	

Maintenance

Fault Finding

All voltages measured with respect to '0' volt line, with $10M\Omega$ input impedance voltmeter or oscilloscope. Voltages measured with 8.5V battery.

NO DISPLAY ON ONE OR MORE DIGITS. Check: --

- (1) Battery voltage with a separate meter, 6.2 to 9V
- (2) Power supply rails: 14V between 13.6 and 25.1V
10V between 9.6 and 17.3V
5V between 5.2 and 9.1V
- (3) Pulse output at TR35 collector. 5V pk-pk, duration 0.1-0.8mS, dependent on brightness control.
- (4) TR42 collector for approximately 200kHz square wave drive to IC2. Voltage pk-pk approximately same as 0-10V supply rail.
- (5) TR19-27 and TR28-34 collectors are switching.
- (6) IC2 outputs.
- (7) VZ 7.0V approximately.
- (8) VR 4.5V approximately.

NO MEASUREMENT ON 1V DC Range. Apply 1V and check:--

- (1) Input wiring and switching path on 1V dc range.
- (2) Reset pulse every 300 ms approximately at TR17 base. 0.6V pk-pk
- (3) Ramp at TR17 collector.
- (4) Comparator output at TR37 collector. 9.5V pk-pk approximately.
- (5) VX relative to 10V. 1.5V
- (6) VX comparator output at TR36 collector. 9.5V pk-pk approximately.
- (7) Check (4) and (6) are present on pins 24 and 23 of IC2.



NO MEASUREMENT ON AC VOLTAGE RANGES. Select 1V range ac and with the input leads connected together, measure the dc level at TR12 collector (6 to 7.5V). Apply 1V ac at 1kHz to the input and check:--

- (1) Input signal at switch side of C10.
- (2) Signal at TR12 collector.
- (3) DC voltage proportional to input signal at R111, C15 junction
- (4) Switch path between ac/dc converter output and the input comparator.



NO MEASUREMENT ON 10V, 100V, 500/1000V AC or DC RANGES. Check the input switching and ac/dc voltage attenuator.

Maintenance

NO MEASUREMENT ON AC DC CURRENT RANGES Check:

- (1) FS2
- (2) Input switching
- (3) R34-37

NO MEASUREMENT ON OHMS RANGES Check:—

- (1) FS1
- (2) Input switching
- (3) TR14 base 3.2V approximately.
- (4) TR13-14
- (5) TR13 emitter ranging resistors and switching.

Component List

Ref.	Description	Pt. No.	Ref.	Description	Pt. No.
R1-R2	27K C.F. 5% 1/8W	21813	R38	1Ω 1% W.W. 2.5W	34230
R3-R4	470K " " " "	32330	R39	1K C.F. 5% 1/8W	21799
R5	68K " " " "	21816	R40	86.6K M.F. 1% 100ppm/°C	32942
R6-R7	10K " " " "	21809	R41	47.5K M.F. 0.5% "	33691
R8	82K " " " "	21818	R42	32.4K " " " "	33690
R9-R10	47K M.F. 2% 100ppm/°C	32938	R43	47K C.F. 5% 1/8 W	21815
R11	33K M.F. 1% " "	32945	R44	100K " " " "	21819
R12	51K " " " "	32946	R45	6.8K " " " "	21807
R13	9.53M " " " "	33678	R46	15K " " " "	28727
R15	10K C.F. 5% 1/8W	21809	R47-54	10K " " " "	21809
R16	100K " " " "	21819	R55	180K " " " "	21822
R17	15K " " " "	28727	R56,57	390Ω " " " "	28722
R18	10M " " 10%	32661	R58-65	220Ω " " " "	21796
R19	10W M.F. 1% 100ppm/°C	32944	R66	10K " " " "	21809
R20	560Ω C.F. 5% 1/8W	21798	R67-69	27K " " " "	21813
R21	56K M.F. 2% 100ppm/°C	32939	R70	68K " " " "	21816
R22	6.8K " " " "	32940	R71	150Ω " " " "	21719
R23-25	10W C.F. 10% 1/8W	32661	R72	56K " " " "	28729
R26	3.44W M.F. 1% 100ppm/°C	32943	R73	180K " " " "	21822
R27	315K M.F. 2% " "	32947	R74	68K " " " "	21816
R28	33K M.F. 0.25% "	32948	R75	22K " " " "	21812
R29	3.29K " " " "	32949	R76,77	27K K " " " "	21813
R30	218Ω " " " "	32941	R78	22K " " " "	21812
R31	2.7W C.F. 10% 1/8W	30756	R79	68K " " " "	21816
R32	56K C.F. 5% 1/8W	28729	R80	180K " " " "	21822
R33	100Ω C.F. 5% 1W	3309	R81-82	390K " " " "	32358
R34	5.62K M.F. 0.25% 100ppm/°C	32950	R83	68K " " " "	21816
R35	88Ω " " " "	32951	R84,85	5.05 M.F. 1% 100ppm/°C	32962
R36	98.2Ω " " " "	32952	R86	A.O.T. MOX 2%	
R37	8.8Ω " " 1W	32953	R87	220K " " " "	28830

Component List

Ref.	Description	Pt. No.	Ref.	Description	Pt. No.
R88	6.8K C.F. 5% 1/8W	21807	C28	1000pF " 5% 1kV	33376
R89	1.245M M.F. 0.25% 100ppm/°C	32963	C29	.47μF " 5%	33372
R90	200Ω MOX 2%	28786	C30,31	0.1μF " 10%	31377
R91	101.85K M.F. 0.25% 100ppm/°C	32964	C32	12.5μF Electrolytic 25V	20775
R92	1M C.F. 5% 1/8 W.	31840	C33	2/10pF Trimmer	32669
R93	220K C.F. 5% 1/8W.	21823	C34	150μF Electrolytic 15V	32175
R94	2.5K PN10B preset pot	28969	C35,37	0.1μF Ceramic ± 80%	19647
R95	500K " " "	33369	C36	100μF Electrolytic 10V	32168
R96	50K " " "	33368	C38	2200pF Ceramic ± 20%	22388
R97	5M " " "	33370	C39	330pF " "	22381
R98	500K PN5B preset pot	32959			
R99	2.5K " " "	32960			
R100	330K C.F. 5% 1/8W.	32357	I.C.1	CA3046	32961
R101	68K " " "	21816	I.C.2	MOS. LS1 DIGITAL	32755
R102	12K 2% MOX	28802			
R103	100Ω PN10B preset pot	29915	ILP1	Neon 16L	29201
R104	220K C.F. 5% 1/8W	21823			
R105	1M " " "	31840	L1	Inductor	33315
R106	330K " " "	32357			
R107	4.7M C.F. 10% 1/8W.	30759	S1	ON/OFF Slide Sw	33302
R108	100Ω C.F. 5% 1/8W	21794	S2	Sw. Wafer Assy.	33307
R109	33K " " "	21814	S3	" " "	33308
R110	10K " " "	21809			
R111	470K " " "	32330	FS1	100mA 50mm	32958
R112	10K PN10B preset pot	29574	FS2	1.5A 50mm	32340
R113	4.7Ω C.F. 5% 1/8W.	29433			
R114	330KΩ C.F. 5% 1/8W	32357	TR1, 2, 4, 5, 7, 12, 16, 18, 25, 28, 30, 32, 33, 36, 37, 41	BC2088	33329
C1	32μF Electrolytic 10V	21212	TR3, 6, 11, 14, 17		
C2	200μF " "	20782	19-24, 26, 27, 35, 38, 39, 40	BC204	33330
C3,4	330pF Polyester ± 20%	33420	T28	BSX20 Select	32956
C5	.022μF Ceramic ± 80%	2663	TR29, 31, 34	BSX20	23307
C6,7	200μF Electrolytic 10V	20782	TR9, 10	2N3819 PAIR	33438
C8	100μF " 25V	32183	TR13	BC209C	33331
C9	0.1μF Ceramic ± 80%	19647	TR15, 42	2N3904	24146
C10	3300pF Polyester ± 20% 160V	33420			
C11	.01μF Ceramic ± 80%	22395			
C12	56pF Ceramic ± 10%	22373			
C13	.047 " ± 80%	2793	All diodes IN4148 except:—		23802
C14	1μF Polyester 10%	31383	D7, 18, 19, 24	IN3595	29330
C15	.33μF " 10%	31380	D1, 2, 11, 12, 14, 15, 16, 17	IN4003	23462
C16	.01μF Ceramic 80%	22395	D25	IN4007	52337
C17	.022μF Polyester 10%	31373	D28	DL33 Display	33328
C18	470pF Sil. mica 5%	4781	D29	Red lit 4	33421
C19	27pF Ceramic 10%	22369		-ve sign	
C20	.01μF " 80%	22395			
C21	27pF " 10%	22369			
C22	.01μF polyester 1%	33851			
C23	150μF Electrolytic 6.3V	32163	C.F. = Carbon film		
C24	6pF Trimmer 1kV	29421	M.F. = metal film		
C25	4.7pF Sil. mica ± 1pF 1kV	3337	MOX = metal oxide		
C26	47pF ± " " ± 1pF	685	W.W. = wirewound		
C27	1000pF Polyester 1%	5103			

This instrument is guaranteed for a period of one year from its delivery to the purchaser, covering the replacement of defective parts other than tubes, semiconductors and fuses. Tubes and semiconductors are subject to manufacturers' guarantee.

We maintain comprehensive after sales facilities and the instrument can, if necessary, be returned to our factory for servicing. The type and serial number of the instrument should always be quoted, together with full details of any fault and the service required. The Service Department can also provide maintenance and repair information by telephone or letter.

Equipment returned to us for servicing must be adequately packed, preferably in the special box supplied, and shipped with transportation charges prepaid. We can accept no responsibility for instruments arriving damaged. Should the cause of failure during the guarantee period be due to misuse or abuse of the instrument, or if the guarantee has expired, the repair will be put in hand without delay and charged unless other instructions are received.

**OUR SALES, SERVICE AND ENGINEERING DEPARTMENTS ARE
READY TO ASSIST YOU AT ALL TIMES.**

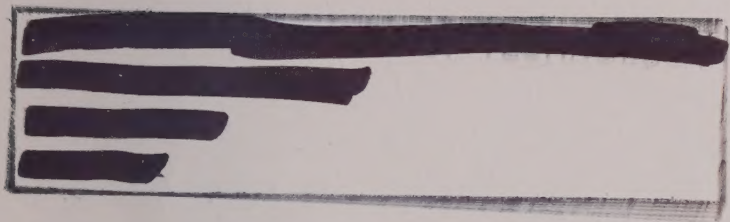
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